

REMARKS

Claims 1-20 are pending in the application and are presented for reconsideration. All remaining independent claims 1, 8, 10, 11, 18, and 20 have been amended. Based on the following Remarks, Applicant respectfully requests that the Examiner reconsider all outstanding objections and rejections, and withdraw them.

In the office action dated September 14, 2007 claims 1-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ikeuchi (WO 03/002054) (hereafter referred to as “Ikeuchi WO”). Applicant notes that US publication US2004/0158175 to Ikeuchi et al. (hereafter referred to as “Ikeuchi US”) and the Ikeuchi WO reference both claim priority to US provisional application 60/300,815 and appear to disclose the same information. Since the Ikeuchi WO reference is not in English, the comments below are based upon the Ikeuchi US publication.

Claim 1 now recites:

1. A method for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising the steps of:
 - determining a gravity compensation control torque value for a first joint;
 - identifying said gravity compensation control torque as being feasible if the relative angular velocity between first and second segment of said first joint is substantially zero; and
 - identifying a gravity compensation control torque feasibility value when said relative angular velocity between said first and second segments of said first joint is not substantially zero, including the steps of:
 - determining a mechanical energy feasibility value of said gravity compensation control torque,
 - determining a metabolic energy feasibility value of said gravity compensation control torque, **the metabolic energy feasibility value based on metabolic efficiencies associated with concentric work and eccentric work,** and
 - calculating said gravity compensation control torque feasibility value based upon said mechanical energy feasibility value and said metabolic energy feasibility value.

Independent claims 10, 11, and 20 recite similar features. The Office Action states that Ikeuchi teaches measuring an internal work volume which is the metabolic energy feasibility value. Ikeuchi's internal work volume is the time integral of the joint power, where joint power is the instantaneous mechanical power which is computed from the product of the joint torque and the joint angular velocity (Equation 3). In contrast, the claimed metabolic work and metabolic feasibility consider the musculoskeletal efficiencies associated with concentric work (the work done when the muscles shorten) and eccentric work (the work done when the muscles lengthen) as set forth in paragraph 33 of the present application, for example which say, in part (emphasis added):

However, metabolically there is a cost. The work requirement to hold body segments against gravity cannot therefore be determined with muscle power or joint power computations...

Concentric work and eccentric work have different metabolic efficiencies which must be considered when calculating metabolic effects (see paragraph [0032] of the present application). Such metabolic effects are not considered in Ikeuchi's internal work volume. In the claimed invention, in an unassisted human motion involving isometric work against gravity, there is no mechanical movement and so the mechanical work is zero but metabolically there is a cost (see paragraph [0033]). Further, the present application discloses (and also claims - based upon the element of "a metabolic energy feasibility value" in claim 1 and also claims 2-3, for example) how to assess the metabolic feasibility of assist torque based on metabolic cost of assisted and unassisted control (see paragraph [0035]). Ikeuchi does not disclose how to assess the feasibility of assist torque based on metabolic cost of assisted and unassisted control. Accordingly, Ikeuchi's internal work volume does not correspond to the claimed metabolic energy feasibility value.

Claim 8 now recites:

8. A method for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising the steps of:
- determining a gravity compensation control torque value for a first joint;
 - identifying said gravity compensation control torque as being feasible if the relative angular velocity between first and second segments of the said first joint is substantially zero; and
 - identifying a gravity compensation control torque feasibility value when the relative angular velocity between said first and second segments of the said first joint is not substantially zero, including the steps of:
 - determining a mechanical energy feasibility value of said gravity compensation control torque, **the mechanical energy feasibility value based on determining whether the assist torque is mechanically feasible,**
 - determining a stability feasibility factor for said gravity compensation control torque, and
 - calculating said gravity compensation control torque feasibility value based upon said mechanical energy feasibility value and said stability feasibility factor.

Independent claim 18 recites similar features. The Office Action also states that Ikeuchi teaches measuring an external work volume which comprehends the claimed determining a mechanical energy feasibility value. Ikeuchi's external work volume is the time integral of the product of the external joint torque and the angular velocity (Ikeuchi Equation 4). The present invention uses power analysis to determine whether an assist torque is mechanically feasible ([0036]), e.g., the power analysis determines whether a given assist torque will lower or increase the muscle work required to execute a given task. The claimed invention uses such power analysis to construct mechanical energy feasibility regions or values based on assist torque ([0036]). Ikeuchi does not disclose mechanical energy feasibility regions or values based on assist torque. Accordingly, Ikeuchi's external work volume does not correspond to the claimed mechanical energy feasibility value.

Accordingly, Ikeuchi does not disclose each and every element of the claimed invention. Similar reasons apply for independent claims 10, 11, 18, and 20 and the remarks above apply thereto. For the above reasons, Applicant respectfully submits that claims 1-20 are allowable over the cited reference. Therefore, Applicant requests that the Examiner reconsider and withdraw all rejections and objections.

In addition, claims 1-20 have been provisionally rejected on the grounds of non-obviousness—type double patenting based upon claims 1-26 of copending US application 10/481,807 (corresponding to the Ikeuchi US publication discussed above). For the reasons described above, Applicant believes that the claims of the present application are patentably distinct from the Ikeuchi application. Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the provisional rejection based upon the Ikeuchi application.

Conclusion

Applicant believes that all of the stated grounds of objection and rejection set forth by the Examiner in the Office Action have been properly accommodated or addressed. Applicant, therefore, respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and withdraw them. The Examiner is invited to telephone the undersigned representative if it is felt that an interview might be useful for any reason.

Respectfully submitted,
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